

Solar storage collector for heat storage, has double wall hollow body with insulated chamber surrounded by outer transparent wall for solar radiation passing through inner wall in heat absorbing layer

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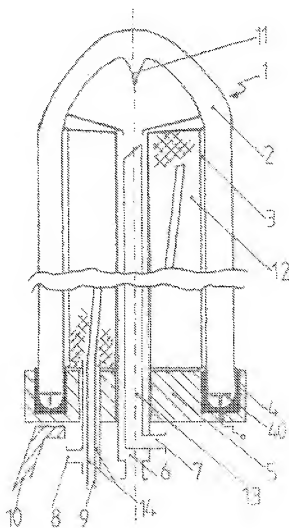
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Abstract of DE 19859658 (A1)

The solar storage collector (1) is formed from an evacuated hollow body (2) with an inner lying absorber (3), a cover (5) a condenser part (11) and a heat carrier conductor. There is also a working medium conduit and an absorbent chamber (12) with conducting components. The hollow body (2) is made of glass. The layer absorbing and storing the heat consists of a silicate microporous material. Independent claims are included for a method of operating the collector.



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The invention relates to a solar memory collector as well as a method to its operation. The collector can become everywhere applied, where at short notice high-quality Nutzwärme is to become provided, whereby the load change periods between loading and unloading condition without diffuse temperature gradient must take place as gradate-like as possible.

To the state of the art a multiplicity from plants belongs to the storage of heat energy such as z. B. Solar power and low-temperature-warm, for example described in DE-OS 32 12 608, DE-PS 30 22 583, DE-OS 43 40 812 and US 4,594,856 for the sorptive heat storage or also of refrigerants (DE-PS 27 20 561 and DE-PS 30 06 733). In company publications (see. Company Dornier prince Solartechnik: "Solar power optimal use. . .") and in the scientific literature, like Passos and. A.: "Simulation OF an inter-memo-end adsorptive Cooling system" in solarly Energy 42 (1989), 103, or Lävemann and. A.: "Airconditioning and energy storage over sorption" in boarding school. Sun forum 1992, Berlin, DGS publishing house Munich 1992, the properties detailed described become. Solar heat collectors from evacuated double walled hollow bodies with inside located, integrated and warm ones storing interiors existing from microporous materials, are in a plurality of embodiments known. Solar memory collectors, which achieve high memory achievements, are fundamental so designed that the solar radiation which can be converted in heat energy occurs low-loss the interior, whereby the warm one with high efficiency does not become to the heat distribution medium medium flowing through the interior transferred and irreversible the environment discharged (z. B. DE OS 4237228). Prerequisite for the function and simultaneous construction principle of a such solar memory collector is that

- is the heat transformation maximum achievable per unit area of the irradiation,
- the converted volume of the inside located heat accumulator on an high temperature level is lifted, simultaneous
- an optimum ratio from irradiation surface to the storage volume adjusted will to reach an high energy storage-dense and
- the warm guidance in a transverse direction so made that formed temperature gradients quick adjust themselves.

To these requirements correspond in particular known solar memory collectors with an high wing taper, to D. h. with cylindrical embodiment with a large ratio of length to diameter. Thus, those succeeds for the function and the passage of the heat carrier required front and not to radiation-depresses involved closure flat-moderate minimum to hold and thus radiation losses not limit. Making more difficult it works with heat accumulators that by these closure flow guidance for the medium, working according to the sorption principle, with silikatischen Adsorbentien preferably water vapor, provided to likewise become to have. The problem will possess the one associated dome shaped, likewise evacuated hood essay with actual known evacuated collector segments, existing from hollow bodies of the type of a Dewar vessel (DE-OS 44 07 968), already by the fact satisfactory dissolved that this only a single, bottom cap to exhibit. The absorber converting the solar radiation in warm ones fills out thereby the surface of the interior positive and an ensured high active surface/volume ratio and thus favourably optimal space-time yields for the heat energy.

Known ones are likewise apparatuses and methods for the operation of reversible sorption processes in heat accumulators, which consist of a multiplicity from next to each other located chambers and with a solid for the adsorption filled are. They communicate at one of their faces or reciprocally over a common vapor space periodic alternate with vaporizers and condensers and step over chamber partition walls alternate with a refreshing and heating heat distribution medium medium into heat exchange (see. DE 33 24 745). It is provided that the intermediate walls themselves are executed as Hohlwände or plumbings for the transport of the heat exchanger medium, whereby additional mounted warm contact areas take over and to the heat distribution medium medium supply the majority of the heat flow between the chambers in the form of fins at least. The apparatuses already permit a periodic, alternate load change with the transmission of Nutzwärme to a consumer, as a temporal and spatial alternation running off of adsorption and desorption bottom high heat of reaction becomes achieved. Due to moderate heat transfer in a transverse direction by the only bad warm one conductive silikatischen solid Sorbentien reaches it however still unsatisfactory thermal efficiencies.

Common adverse is known apparatuses and methods for the supply of energy in the form of solar radiation, for the conversion of periodic heat flows to an optimal large heat-storage capacity and its conversion to high energy use achievements by means of the heat carrier that with an enlargement of the yardstick in one of the intended geometric main directions, for example during a preferred direction in one of the intended spatial longitudinal extents, with the alternate load change temporal intermediate periods arise, in which the temperature stroke not predominant gradate-like made and a local diffuse course shows.

Object of the invention is the development of a solar memory collector, which exhibits an enlarged warm guidance ability of its inner structural elements with simple, constructional and package-like structure, an enlargement of the yardstick in a linear dimension direction possible and at least a face closed in itself possesses, whereby preferred in a longitudinal



direction, in addition, in a transverse direction becomes in the respective adsorption or desorption period an elevated Wärmeausgleich made and an approximated stepped sudden temperature change by quick heat transfer in the intermediate periods of the load change achieved. This object becomes dissolved by the solar memory collector more near characterized in the claims and the designs.

The collector consists transporting medium of a double walled hollow body, preferably material existing storing with an isolating area umschlossen of an outer wall from a transparent material for the passage of solar radiation by an inner wall into a warm one absorbing layer and into a warm one from a silikatischen microporous cloth, a simultaneous of a warm one interior formed flow throughable. The solar memory collector 1 is characterised in that it from an evacuated hollow body 2 with an inside located absorber 3, a lid 5, a partial condenser 11 and a heat distribution medium guidance 13 as well as a medium guidance 14 formed becomes according to invention and a Sorbensraum 12 with guidance installations includes. The guidance mechanisms ensure a preferred balance for the heat transfer in transverse direction, during gradients material in a longitudinal direction a favourable balance by diffusion with simultaneous favourable heat conduction and - transmission to take place can.

The invention becomes more near explained on the basis an embodiment. In the associated designs show:

Fig. 1 solar memory collector (single-step),

Fig. 2a-d package-like installations for the warm guidance in geometric styling, in the section,

Fig. 3 flow guidance of the vapor phase within the installations by guidance edges, after Fig. 1,

Fig. 4 flow guidance of the heat carrier after Fig. 1 and Fig. 2,

Fig. 5 flow guidance in the absorber after Fig. 1, in the section,

Fig. 6 step of the multistage solar memory collector, as shot,

Fig. 7 procedure pattern.

The solar memory collector 1 (Fig. 1) consists of an evacuated hollow body 2 with an absorber 3, which is 5 connected over a seal 4 with a lid. In the lid 5 are the heat distribution medium inlet 6, the heat distribution medium discharge opening 7, the medium inlet 8 and the medium discharge opening 9 arranged. At the lid 5 is the fastening 10. In the hollow body 2 is the partial condenser 11 mounted. Within the absorber 2 is the Sorbensraum 12. The heat distribution medium inlet 6 and the heat distribution medium discharge opening 7 flow to preferred into a coaxial or axial eccentric designed heat distribution medium guidance 13. The medium guidance 14 formed made of medium inlet 8 and medium discharge opening 9 runs from each other separate or axial eccentric and in the height stepped. The guide surfaces 20 (Fig. 2) consist of an head portion 21 and a foot portion 22, which are 23 connected with one another over the bar. Between different head portions 21 are the joints 24. The guide surfaces 20 inertial at their axial confinements the guidance edges 25 (Fig. 3). The bars 23 are positive connected with the absorber 3.

A particular embodiment consists of the fact that the absorber 3 and the bars 23 form an unit and represents resilient, preferred lying close elements resilient at the inner wall of the hollow body. It is at least one bar 23 with an head portion 21 and a foot portion 22 provided, between which the Sorbensraum 12 is. Special embodiments plan that the bars 23 helical (Fig. 2a), mäanderförmig (Fig. 2e), rosettenförmig or star shaped (Fig. 2b and Fig. 2d) are or in form of a sun gear (Fig. 2c) are present. They can possess naturally also different one, simple geometric shapes. In Fig. 2f is shown that the bars 23 can consist themselves of resilient, to the inner wall of the hollow body 2 adapting elements. The foot portions 22 are preferred positive 13 connected with the heat distribution medium guidance.

The guidance edges 25 run regarding an horizontal middle cutting plane of the hollow body 2 to each other reflected offset or regarding a diametric plane reflected a bottom obtuse angle same. The Fig. show 3 concerning adjacent guidance edges 25 an aligned, an offset aligned as well as an offset and twisted aligned array.

The absorber 3, the head portions 21, the foot portions 22 as well as the bars 23 consist preferred of a blackened, predominant cupreous material, the absorber 3 in addition, of one the good warm one conductive polymere, porous, preferably a graphitieren matte-like Gestrück. The partial condenser of 11 reduced fittings of water vapor with the load change and secures thereby an optical transparency of the hollow body 2.

Particularly within helical arrays it can be convenient to attach between the bars 23 elements 29 like pins or knobs which serve for the spacer attitude, so that a diametric connection comes to the heat distribution medium guidance 13. The guidance mechanisms are altogether package-like composed and favour thus small time for the structure and the maintenance of the plant.

A special embodiment of the medium guidance 14 sees the flow guidance in an axial and eccentric double tube 28 passed by the bars 23 forwards (Fig. 4). Separate openings 26 and 26' in the medium inlet 8 become and medium discharge opening 9 introduced, which become larger also over the height of the Sorbensraumes 12 and to which over the height to increasing flow resistance correspond themselves to the pipe flow. Thus a always uniform feed of the Sorbensraumes becomes achieved. The medium guidance can be also in the wall of the absorber 2 arranged, that in this case from a microporous or matte-like material exists (Fig. 5). The lid 5 can likewise be as hollow bodies and evacuable designed.

Multistage apparatuses become from at least two connected with one another shots 30 (Fig. 6) formed. From the guide surfaces 20 22 packets existing with the parts 21 and exhibit the same described features. The heat distribution medium guidance 13 as well as the medium guidance 14 will between adjacent shots convenient as plug connections executed, it can however just as out in the ratio to the hollow body 2 lateral arranged connections exist.

In the associated method the solar memory collector according to invention becomes in cyclic-periodic manner operated (Fig. 7). In the initial step an adsorbate, above all a moist or air, becomes preferably in the temperature range between 5 DEG C and 20 DEG C, satisfied with saturated steam, by the medium inlet 8 the Sorbensraum 12 supplied. The air depleted at water vapor leaves the medium discharge opening 9. Over the heat distribution medium inlet 6 become then an hot heat distribution medium medium, preferably a heat distribution medium oil or an also bottom excess pressure

standing hot water, with 120 DEG C to 150 DEG C the interior of the collector supplied. The desorption runs up to an equilibrium state predetermined by warm and pressure-dependent material values. Simultaneous one can become stored Überschusswärme over the heat distribution medium discharge opening 7 the Sorbensraum 12 removed. During the unloading phase a reversal of the flow direction becomes both for the heat distribution medium and adjusted for the medium stream. The heat distribution medium stream becomes by the heat distribution medium inlet 6 supplied and 7 returned by the heat distribution medium discharge opening. In the Sorbensraum 12 heat of adsorption becomes released and outward discharged.

Simultaneous one or during a respective daily period can become the energy of the solar radiation there over the absorber 3 and the bars 23 the Sorbensraum 12 supplied and due to the good isolating effect of the hollow body 2 with high efficiency stored. In the night period the isolating effect ensures for a strong confinement of losses by radiation.

By the high temperatures the Legionellenbildung and their Vermehrung in the heat distribution medium medium become excluded. The function of the solar memory becomes ensured over actual known evaporation and condensation stages as well as control circuits.

A special embodiment of the invention and their effect becomes on the basis Fig. 7 explained. Both in the adsorption and in the desorption phase made even with high wing taper of the apparatus a consistent counter current guidance of the material and heat flows. The medium stream are the adsorption and/or. Desorption fronts always against directed. The counter current guidance of the heat carrier limits a developing of dense layerings to a large extent in the bottom load enterprise of the apparatus over their longitudinal extent. Since the temperatures of all flow means change along their transfer surfaces, as a result of it the entire Sorbensraum seizing high integral average value of the temperature differences between the flow in and - arises discharge openings, which are in the transverse directions favourably a cross current for the heat transfer superimposed.

By the favourable construction and the function of the solar memory collector according to invention in particular the subsequent application possibilities can become mentioned:

- on buildings the collector can become both and single like also in groups multiple connected plant, in particular as short time memory high memory density for the localbonded Heisswasserversorgung used
- for vehicles with internal combustion engines z can. B. high-quality warm ones for the starting procedure in cold climatic areas or the cold season provided become.
- in hot climate zones the collector can be in the range of the focus of optical lens or mirror systems arranged.

The solar memory collector represents a decorative architectural structural element, which can become also used as shining device, in particular for advertising purposes, if the hollow body becomes additional with corresponding electrodes 40 and a remainder gas filling from noble gases provided.

Reference symbol list

- 1 solar memory collector
- 2 hollow bodies
- 3 absorber
- 4 seal
- 5 lids
- 6 heat distribution medium inlet
- 7 heat distribution medium discharge opening
- 8 medium inlet
- 9 medium discharge opening
- 10 fastening
- 11 partial condenser
- 12 Sorbensraum
- 13 heat distribution medium guidance
- 14 medium guidance
- 20 guide surface
- 21 head portion
- 22 foot portion
- 23 bar
- 24 joint
- 25 guidance edge
- 26 opening
- 26 ' opening
- 28 double tube
- 29 element
- 30 shot
- 40 electrode



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1. Solar memory collector from a double walled hollow body, preferably material existing storing with an isolating area for the passage of solar radiation by an inner wall into a warm one absorbing layer and into a warm one from a silikatischen microporous cloth, a simultaneous interior formed, characterised in that the solar memory collector (1) from an evacuated hollow body (2) with an inside located absorber (3), flow throughable umschlossen of an outer wall from a transparent material, of a warm one transporting medium, a lid (5), a partial condenser (11) and a heat distribution medium guidance (13) as well as a medium guidance (14) formed becomes and a Sorbensraum (12) with guidance installations includes.
2. Collector according to claim 1, characterised in that of the hollow bodies (2) of glass consists.
3. Collector according to claim 1 and 2, characterised in that the guidance installations from guide surfaces (20) with an head portion (21) and a foot portion (22) exist, which are connected with one another over the bar (23) and exhibit guidance edges (25), whereby the bars (23) with the absorber (3) are positive connected, form an unit and represent preferred at the inner wall of the hollow body (2) resilient lying close absorber elements.
4. At least collector according to claim 1 to 3, characterised in that a bar (23) with an head portion (21) and a foot portion (22) connected is, between which the Sorbensraum (12) is and that the bars (23) various geometric shapes exhibit can, mäanderförmig, helical in particular, rosettenförmig or star shaped is or in form of a sun gear to be present.
5. Collector according to claim 1 to 4, characterised in that the heat distribution medium inlet (6) and the heat distribution medium discharge opening (7) form of a coaxial or axial eccentric as double tube (28) designed heat distribution medium guidance (13) the Sorbensraum (12) lead into.
6. Collector according to claim 1 to 5, characterised in that the medium guidance (14), formed from medium inlet (8) and medium discharge opening (9), from each other separate or axial eccentric and in the height stepped runs.
7. Collector according to claim 1 to 6, characterised in that the guidance edges (25) regarding an horizontal middle cutting plane of the hollow body (2) reflected offset run to each other or that they regarding a diametric plane reflected a bottom obtuse angle same run.
8. Collector according to claim 1 to 7, characterised in that the guidance edges (25) regarding an horizontal cutting plane between two hollow bodies (2) reflected offset run to each other or that they regarding a diametric longitudinal plane reflected a bottom obtuse angle same run.
9. Collector according to claim 1 to 8, characterised in that between the bars (of 23) elements (29) like pins or knobs is, which serve for the spacer attitude.
10. Collector according to claim 1 to 9, characterised in that of the hollow bodies (2) with electrodes (40) is provided.
11. Method for the cyclic-periodic operation of the solar memory collector after or the several claims a 1 to 10 and for the utilization of very low-temperature heat energy with the object of the heat storage, with which a Sorbat, preferably water, becomes by warm ones with a temperature up to 200 DEG C from a Sorbens endothermic desorbed, the volatile Desorbat condensed and with the desorption sorbents the exothermic sorbent as adsorbate, depleted developed, at Sorbat, again supplied becomes, characterised in that during the adsorption phase the heat distribution medium stream by the heat distribution medium inlet (6) supplied and by the heat distribution medium discharge opening (7) returned, which medium stream by the medium inlet (8) supplied and by the medium discharge opening (9) returned becomes, and that during the following desorption phase both for the heat distribution medium stream as well as the medium stream a flow reversal made.
12. Process according to claim 11, characterised in that with load change a substantial portion by radiation supplied and in the absorber (3) of the energy for direct baking of the Sorbensraum (12), converted in warm ones, used becomes that Überschusswärme in the Sorbensraum (12) stored and that radiation losses are reduced by the hollow body (2) strong.